J. Mod. Power Syst. Clean Energy (2013) 1(2):89–90
DOI 10.1007/s40565-013-0027-x

Guest editorial: special issue on risk evaluation and management for future electric power systems

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Providing a reliable and economical supply of electricity to customers has always been of paramount importance of electric power systems. The failures of electric power systems can have enormous economic costs and serious negative social impacts. For example, half of India's population was affected by the massive blackout of India's power grid in 2012, which was the largest power system failure in history. Therefore, risk issues have been extensively and continuously recognized and studied from viewpoints of both power system planning and operation for decades. Moreover, recently the high renewable energy resources (RES) penetration of existing and future power systems will also have significant impact on system security and reliability due to fast fluctuation and unpredictable characteristics of RES. It can have either positive or negative impacts on the risk of power system operation and planning. The reliable and economical operation of future electric power systems requires development of new concepts, models, and methodologies for risk evaluation and management of power systems.

This special issue is dedicated to address this need. Thirteen original papers are brought together to discuss various aspects of risk evaluation and management of future power system operation and planning. The papers cover the topics outlined as follows:

Yusheng Xue and Shijie Xiao propose the concept of "generalized congestions" for analyzing the fundamental factors causing the India's massive blackouts and inherent evolution law of blackouts. The importance of strong smart grids and the multi-space- time-scale cooperative blackout defense system for reducing the risk of power, energy and environment systems is analyzed.

Salvador Pineda and Antonio J. Conejo's paper describes electricity options as instruments to manage two main risks faced by power producers in the deregulated environment: price and production-availability risks. A multi-stage stochastic programming model for determining the optimal portfolio of forward contracts for risk-averse power producers is developed considering the pool price volatility and forced outage rate of generators.

Anatoly Lisnianski and Hanoch Ben Haim propose a method for evaluating short-term reliability of generators based on utilizing Lz-transform for reducing the computational complexity. The proposed method could be very useful for power system security analysis and short-term operating decisions.

Ning Zhang, Chongqing Kang et al develop a framework for assessing the mid-short-term risk of power system operation considering the impacts of the external environment such as ice flashover, lightning flashover and bird damage.

Chao Qin and Yixin Yu study the impact of the doubly-fed induction generators (DFIG) on electromechanical oscillation modes of power systems, which is widely used in the large wind farms. A new global electromechanical oscillation mode caused by the integration of DFIG is determined, which is important for secure operation of power systems with high integration of wind power.

The paper by Miao Lu et al proposes a Monte Carlo simulation method for assessing transient stability risk of power systems considering the detailed model of DFIG and various stochastic factors during power system operation.

The paper by Qin Wang et al presents a new real-time electricity market model called the "risk- based security-constrained economic dispatch", in which the system risk

Received: 25 July 2013 / Accepted: 18 August 2013 / Published online: 7 September 2013

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is employed to evaluate the system's overall security level.

The paper by Wenping Qin, Peng Wang et al investigates power system reliability from the perspectives of both real and reactive power. A load shedding technique for post contingencies are implemented to determine the contributions of real and reactive power in system reliability for determining an optimal way to release network violation.

Xi Yang et al proposes a master/slave parallel computing architecture for conducting contingency analysis (CA) during real-time power system operations, which can speed up the computation time through high performance computing.

Yi Ding, Weixiang Shen et al utilize the Universal Generating Function (UGF) technique to evaluate reliability of large-scale PV systems. Reliability based cost analysis of PV systems is also conducted for providing informative metrics to determine the economically optimal one.

Lin Cheng et al analyze the impact of wind turbines outage probability on system reliabilities considering different factors: running time, operating environment, operating conditions and wind speed fluctuations. A multi-state wind farm model is also developed in the paper.

The paper by Hongtao Wang et al develops a dynamic probabilistic production simulation of a power system with wind power penetration based on improved UGF techniques.

The paper by Jie Huang, Feng Xue et al studies the policy effectiveness, cost effectiveness and dynamic efficiency of different policy mixtures between emission trading and renewable energy subsidy based on a novel dynamic power system simulation platform.

I would like to express my heartfelt thanks to all of the authors for their innovative and original work. I am grateful to all reviewers for their efforts in improving the quality of the papers. I also wish to express my gratitude for Editor-in-Chief Yusheng Xue, who suggested the idea of the special issue and provided guidance. Finally I would appreciate Ms. Qing Wang and Dr. Xiaorong Gu's support and suggestions during the whole process.

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July 25, 2013